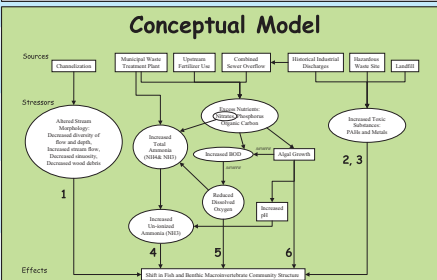
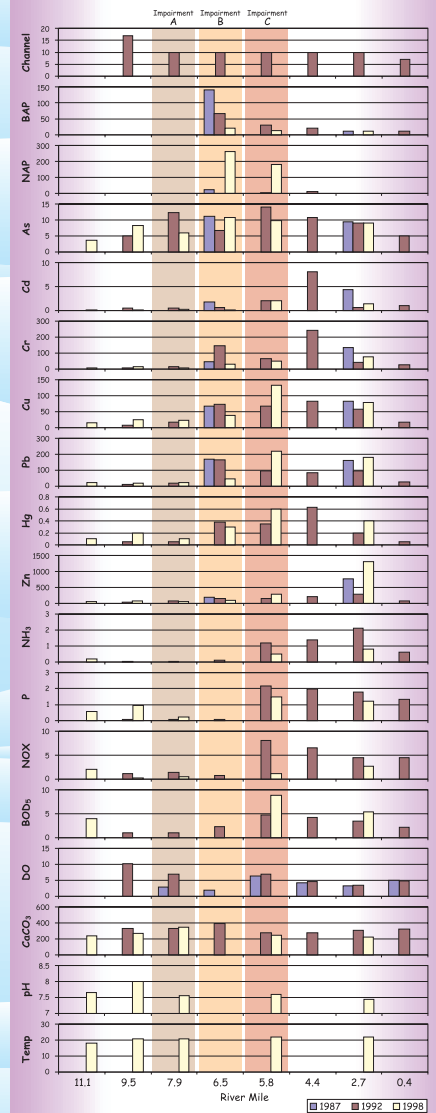
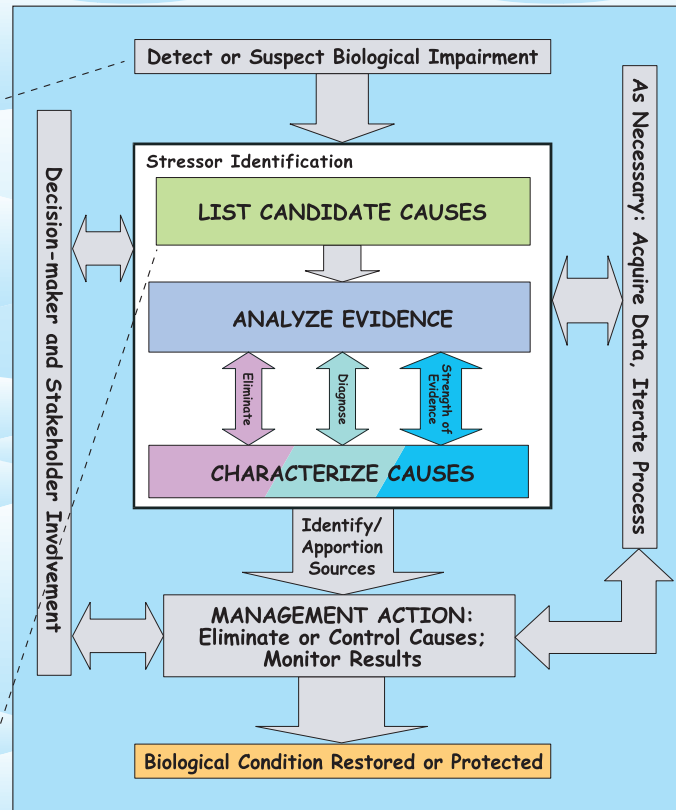


**Detect or Suspect Biological Impairment:** Biological Criteria for Fish and Invertebrate Assemblages were not met in segments of Little Scioto River.

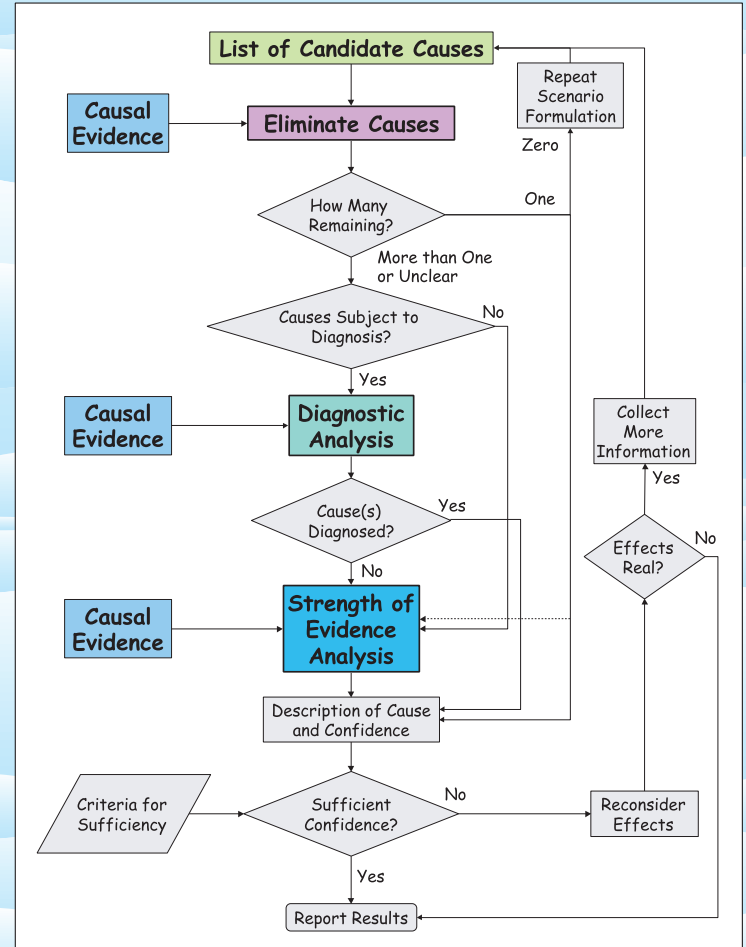


- ### Candidate Causes
- Channelization
  - PAH contamination
  - Metal contamination
  - Low DO / High BOD
  - Nutrient Enrichment
  - Ammonia Toxicity



### Candidate Causes Remaining After Elimination

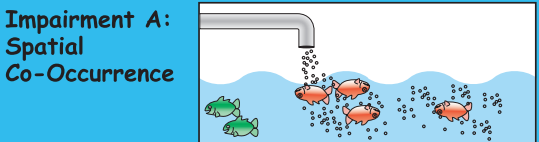
	RM 7.9 A	RM 6.5 B	RM 5.8 C
Channelization	Yes	No	No
Metal Contamination	Yes	Yes	Yes
PAH Contamination	No	Yes	No
Low DO/BOD	No	Uncertain	No
Ammonia	No	No	Yes
Nutrient Enrichment	No	No	Yes



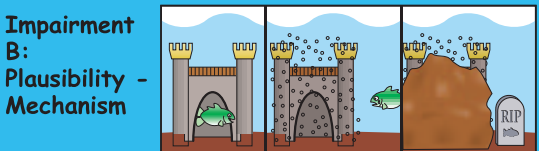
### Acknowledgments

The authors recognize the scientific contributions of Susan Norton, Glenn Suter, Jeroen Gerritsen, and Ohio EPA including Dave Altwater, Bernie Counts, and Chris Yoder. Graphics support was ably provided by Keith Adams.

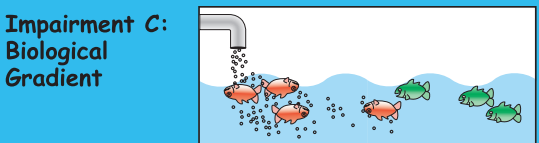
### Strength of Evidence Analysis



Impairment A	Channelization	Metal Contamination	RM 7.9
Co-occurrence	The Little Scioto River is channelized at RM 7.9. The degree of channelization is moderate to severe. The degree of channelization is moderate to severe. The degree of channelization is moderate to severe.	Metals were detected at RM 7.9. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	0
Consistency of Association	Channelization appears to be the dominant cause of impairment. The degree of channelization is moderate to severe. The degree of channelization is moderate to severe. The degree of channelization is moderate to severe.	Metals were detected at RM 7.9. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	-
Feasibility: Mechanism	Channelization can alter hydrology, changing the physical structure of the stream and the characteristics of the water.	Metals can be toxic to fish and invertebrates. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	-
Feasibility: Stream-Response	Channelization can alter hydrology, changing the physical structure of the stream and the characteristics of the water.	Metals can be toxic to fish and invertebrates. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	-



Impairment B	PAH Contamination	Metal Contamination	RM 6.5
Co-occurrence	PAHs were detected at RM 6.5. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe.	Metals were detected at RM 6.5. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	-
Consistency of Association	PAHs were detected at RM 6.5. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe.	Metals were detected at RM 6.5. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	-
Feasibility: Mechanism	PAHs can be toxic to fish and invertebrates. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe.	Metals can be toxic to fish and invertebrates. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	-
Feasibility: Stream-Response	PAHs can be toxic to fish and invertebrates. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe. The degree of PAH contamination is moderate to severe.	Metals can be toxic to fish and invertebrates. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	-



Impairment C	Metal Contamination	Ammonia	Nutrient Enrichment
Biological Gradient	Metals were detected at RM 5.8. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	Ammonia was detected at RM 5.8. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe.	Nutrients were detected at RM 5.8. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe.
Strength of Association	Metals were detected at RM 5.8. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	Ammonia was detected at RM 5.8. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe.	Nutrients were detected at RM 5.8. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe.
Feasibility: Mechanism	Metals can be toxic to fish and invertebrates. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	Ammonia can be toxic to fish and invertebrates. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe.	Nutrients can be toxic to fish and invertebrates. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe.
Feasibility: Stream-Response	Metals can be toxic to fish and invertebrates. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe. The degree of metal contamination is moderate to severe.	Ammonia can be toxic to fish and invertebrates. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe. The degree of ammonia contamination is moderate to severe.	Nutrients can be toxic to fish and invertebrates. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe. The degree of nutrient enrichment is moderate to severe.

### Probable Causes of Impairment

- Impairment A:** **Channelization** - a syndrome of multiple stressors including siltation, low dissolved oxygen, and altered energy source. Metals are unlikely.
- Impairment B:** **Polyaromatic hydrocarbon (PAH)** contamination is sufficient to cause all impairments. Metal contamination and low dissolved oxygen may be masked by PAH.
- Impairment C:** **Nutrient enrichment** alone is sufficient to cause impairment. Ammonia may also be efficient. Metal contamination may be masked and become evident when nutrient/ammonia is reduced.